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Responses of Birds and Small Mammals to Clearcutting in a Subalpine Forest in Central Colorado

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Total numbers of birds were not significantly changed after 36% of a 100-acre timber stand was harvested in 12, small clearcuts. A small, postharvest decline occurred in the "foliage nesting" and "picker and gleaner" feeding guilds. There was no significant change in small mammal populations after timber harvest.

Keywords: Nongame birds, small mammals, patch clearcutting, wildlife habitat.

Management Implications

The small, circular, clearcut patches, where 36% of the drainage was cut to increase water yield, had little adverse effect on small mammal and song bird populations. There was an increase in chipmunks following patch clearcutting, but changes in populations of other small mammals could not be attributed to cutting.

After cutting, an increase in bird species diversity was noted in the drainage with clearcut patches, but the estimated bird populations were slightly lower. Postharvest populations of ruby- and golden-crowned kinglets were significantly lower on the treated drainage. Most of the decline was accounted for by birds in the picking and gleaning feeding guild and foliage nesting guild. Harvesting timber in small clearcuts should provide habitat for those wildlife species requiring early successional stages.

Introduction

Subalpine forests are the largest and most valuable timber resource in Colorado and Wyoming (Alexander 1974a). Subalpine forests also yield more water than other vegetation types and are valuable as wildlife habitat, for recreation, and as scenic areas (Alexander 1974b). Clearcutting in circular patches, with diameters 5 to 8 times tree height, has been shown to be an acceptable forest management practice to increase water yield; this also should improve habitat for some wildlife species while degrading it for others (Troendle and Leaf 1981, Gary 1980).

Based on pellet groups counted, clearcuts smaller than 20 acres (8.1 ha) in the subalpine forest-type in Arizona were heavily used by deer (*Odocoileus* sp.) and elk (*Cervus elaphus canadensis*), but evidence of activity declined in larger openings (Reynolds 1966). In subalpine forests of central Colorado, deer use was greater on clearcut strips than in adjacent uncut timber (Wallmo 1969), and strips 200 feet (61 m) wide were used more than narrower or wider openings. Tomm et al. (1981) found that harassment was the most important factor influencing use of clearcuts by moose (*Alces alces*) in Alberta. Deer exhibited a strong preference for peripheries of harvested areas, and use of openings declined sharply at 330 feet (100.5 m) from cover.

According to Hagar (1960), clearcutting 10- to 20-acre (4- to 8-ha) blocks of Douglas-fir (*Pseudotsuga menziesii*) in northwestern California caused an immediate change in avian species composition. Total number of birds declined initially, but numbers recovered within 1 year. Franzreb (1977) compared bird populations in mixed conifer forests in Arizona where logging reduced the basal area of trees from 221 square feet to 41 square feet per acre (50.9 m^2 to 9.5 m^2 per ha). Although snags were left standing, there was about a 13% reduction in bird populations.

Numbers of small mammals in clearcuts have been compared with those in uncut forests in west-central Oregon (Gashwiler 1970). Deer mice, Townsend's chip-

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munk (*Eutamias townsendii*), Oregon voles (*Microtus oregoni*), and snowshoe hares (*Lepus americanus*) increased after clearcutting. Red-backed voles (*Clethrionomys occidentalis*), Douglas squirrels (*Tamiasciurus douglasii*), and northern flying squirrels (*Glaucomys sabrinus*) were found before logging on the clearcut area but were not present after slash was burned. Tevis (1956) reported that populations of red-backed voles were influenced more by slash left on the ground than by timber harvest. V. H. Reid[3] found little difference in numbers of deer mice, red-backed voles, and heather voles between clearcuts with slash and uncut areas in subalpine forests on the Fraser Experimental Forest, Colorado. He reported more chipmunks, shrews, and montane voles (*Microtus montanus*) on cut than on uncut areas. Other authors have reported on small mammal populations in various timber types, but information concerning response of bird and small mammal populations in the subalpine to timber harvest is generally lacking.

The study reported here, conducted from 1975 through 1979, was a cooperative investigation by personnel of the U.S. Fish and Wildlife Service and U.S. Forest Service to evaluate the effects of small patch clearcutting on resident birds and mammals. The described harvest methodology is designed to maximize water production in the subalpine forests of the central Rockies.

Study Area

The study site, Deadhorse Creek, is on the Fraser Experimental Forest, in central Colorado (Alexander and Watkins 1977). The investigation was conducted on two adjacent, relatively steep, south-facing, 100-acre (40-ha) drainages at about 10,000 feet (3,050 m) elevation (fig. 1). The area is occupied by closed, overmature subalpine timber consisting of Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) on the wetter locations, and lodgepole pine (*Pinus contorta*) on the drier sites.

Species composition in understory vegetation is simple, and ground cover was minimal on drier sites, consisting mainly of *Vaccinium* spp. and other low shrubs, a few forbs, and a sedge. On wetter sites, as in drainages or small basins, many more species of forbs and grasses are present, and vegetative cover is much more abundant.

The drainage to be treated contained 12 circular plots of 3 acres (1.2 ha) each, which were clearcut in 1977. These plots were distributed systematically over the entire 100-acre watershed (fig. 1). This logging method precluded comparing effects of clearcutting individual plots with no cutting on the same drainage. The alternative comparison adopted here was to consider the entire 100-acre (40-ha) watershed containing the 12 clearcuts as the cutting treatment. A total of 36 acres (14.4 ha) or 36% of the drainage was harvested.

[3]*U.S. Fish and Wildlife Service (Retired), personal communication.*

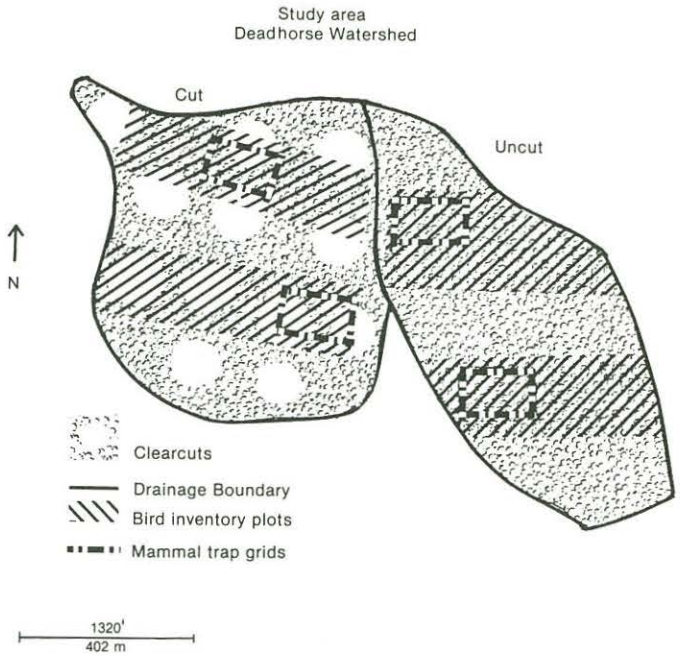

Fig. 1. Two small drainages of Deadhorse Watershed that served as study areas. Fraser Experimental Forest, Colorado.

Methods

Two 25-acre (10-ha) sampling plots were established on the drainage to be treated, and two were selected on an adjacent untreated drainage which served as a control. Significant differences ($P \leq 0.05$) in population density estimates of birds and number of mammals captured between drainages (pre- and posttreatment) were determined by a two-factor repeated measure analysis of variance. For those species indicating a significant difference ($\alpha = 0.05$), Duncan's multiple range test was performed to determine the source of the differences among the interaction means. Those species with significant differences are indicated in tables 1 and 2.

Small mammals were livetrapped in each sampling plot, on 9 × 11 grids, with 50-foot (15.2-m) spacings between traps (fig. 1). One Sherman live trap was placed at each station, and traps were operated for 6 days.

Table 1. Number of individual animals caught on uncut and patch clearcut subalpine forest in central Colorado. Summarizes 2 years pre- and 2 years posttreatment small mammal captures.[1]

	Treated drainage		Uncut drainage	
	Pre	Post	Pre	Post
Red-backed vole	99 a	205 a	79 a	156 a
Least chipmunk	32 a	64 b	32 a	43 a
Deer mouse	10	9	23	8
Montane vole	0	0	6	5
Masked shrew	6	8	1	3
Other mammals[2]	1	7	6	5
Total	148	293	147	220

[1]*Numbers followed by the same letter are not significantly different (P = 0.05). Duncan's multiple range test.*

[2]*Other mammals caught in low numbers are listed in appendix I.*

Table 2. Estimated bird densities [birds/100 acres (40 ha)] by species, nesting, and foraging guilds on uncut and patch clearcut subalpine forest in central Colorado. Values are means of 2 years pretreatment and 2 years posttreatment density estimates.[1]

Bird species	Foraging guild	Nesting guild	Treated drainage		Uncut drainage	
			Pre 1976-77	Post 1978-79	1976-77	1978-79
Williamsons' sapsucker	HT	CD	17	9	12	5
Hairy woodpecker	HT	CD	<1	3	5	6
Northern flicker	GF	CD	7	9	4	<1
Olive-sided flycatcher	AF	FN	0 a	5 b	<1 a	0 a
Western flycatcher	AF	CD	11 a	5 b	23 c	4 b
Mountain chickadee	PG	CD	44	27	50	45
Red-breasted nuthatch	PG	CD	15	13	3	5
Golden-crowned kinglet	PG	FN	5 a	0 b	3 b	0 b
Ruby-crowned kinglet	PG	FN	56 a	38 b	54 a	89 a
Townsend's solitaire	GF	GN	14	9	14	13
Hermit thrush	GF	FN	29	25	26	29
American robin	GF	FN	18	3	16	<1
Yellow-rumped warbler	PG	FN	41	57	47	80
Lincoln's sparrow	GF	GN	0	5	0	0
Song sparrow	GF	GN	0	4	0	0
Dark-eyed junco	GF	GN	47	57	52	58
Other birds[2]			3	3	5	3
Total			307	272	314	337
Foraging guilds						
PG (Pickers & gleaners)			161 a	135 a	162 a	219 b
GF (Ground feeders)			115	112	112	100
HT (Hammerers & tearers)			17	15	17	14
AF (Aerial feeders)			14 a	10 b	23 c	4 d
Nesting guilds						
CD (Cavity & depression)			94	69	102	68
FN (Foliage nesters)			151	128	146	198
GN (Ground nesters)			61	75	66	71

[1] *Within species or guilds, numbers followed by no letter or the same letter are not significantly different (P = 0.05) (Duncan's multiple range test).*
[2] *All birds observed are indicated in appendix I.*

Each mammal caught was ear-tagged and released. After livetrapping, a line with 20 snap-trap stations was placed through the center of the livetrap grid and operated for 3 nights after livetrapping. Three snap traps were placed at each station. Trapping was conducted in late August for 2 years before and 2 years after timber harvest. Mammals trapped in 1977 during timber harvest operations are not reported, because timber cutting and trapping was done simultaneously.

Birds were counted on two 25-acre (10-ha) grids on each drainage (fig. 1). The spot-map method (Kendeigh 1944) was used to enumerate birds, using eight counts per breeding season. Sampling was done early in spring, as soon as snow conditions permitted access to the plots, and continued until breeding activity was completed (usually from about June 10 through July 10). Surveys began one-half hour after sunrise and were completed in about 3.5 hours. Birds were counted on the treated and untreated drainages 2 years before logging, including the year of harvest, and 2 years afterward. Logging was delayed until after the bird surveys were completed in 1977.

The treated drainage was logged in summer 1977. About 10,000 fbm per acre (2,296 m^2 per ha) were harvested, and considerable volumes of slash were left on the ground. Many snags of various sizes were left, but many of these subsequently blew down. Snag numbers and use by cavity-nesting birds was reported by Scott et al. (1978).

Results

Mammals—Thirteen species of small mammals were captured, but red-backed voles[4] and least chipmunks were the only species caught on all plots during all years of sampling (table 1), and are the only species tested for differences. Deer mice were captured on each plot but not in all years. The number of mammal captures varied between years regardless of treatment. There was a 94% increase in mammal captures on the treated drainage after treatment and a 50% increase on the untreated drainage. The ANOVA test indicated that the interaction effect between drainages was not significant.

Red-backed voles were the most abundant species and accounted for much of the increase in captures on both drainages after treatment when the number of red-backed voles caught increased by 107% on the treated drainage and 97% on the untreated drainages.

[4] *Scientific names of birds and mammals on the study area are given in appendix I.*

Because of the large increase on the uncut drainage, the interaction effect was not significant. The percentage of red-backed voles caught in traps placed in the clearcuts after logging is compared with those caught at the same trap locations before harvest (fig. 2). The number caught in clearcuts was not significantly (one-way ANOVA) different from those caught in traps located in uncut areas before or after timber cutting.

Chipmunks were the second most common mammal. The two-factor repeated measures ANOVA test indicated that there were differences in the chipmunk captures between drainages and time. According to Duncan's multiple range test, the number of chipmunks captured on the treated drainage after cutting was significantly higher than that caught before cutting on the cut and uncut drainage and different than those caught on the uncut drainage after treatment. Within the clearcut treatment drainage, chipmunks favored the clearcuts. More were caught in traps placed in the cut areas after logging than at the same trap placements before logging (fig. 2).

Birds—Species composition and population densities before and after timber harvest are shown in table 2. Numbers of birds fluctuated from year to year on uncut and treated drainages. There were no significant differences in densities of individual species between treated and untreated drainages before logging except for the western flycatcher. Posttreatment estimates of western flycatchers were significantly lower than pretreatment estimates on both drainages. Because both drainages responded similarly, the result may not have been caused by logging. After clearcutting, populations of ruby-crowned kinglets were significantly lower on the clearcut compared with the uncut drainage. Mountain chickadees also declined after timber harvest on the treated drainage but not significantly.

Numbers of birds, classified according to nesting and feeding guilds, are shown in table 2. There were significantly fewer birds in the picking and gleaning and aerial feeding guilds on the treated drainage after logging. The decline of aerial feeders (mostly western flycatchers) was greater on the untreated drainage after logging than on the logged drainage.

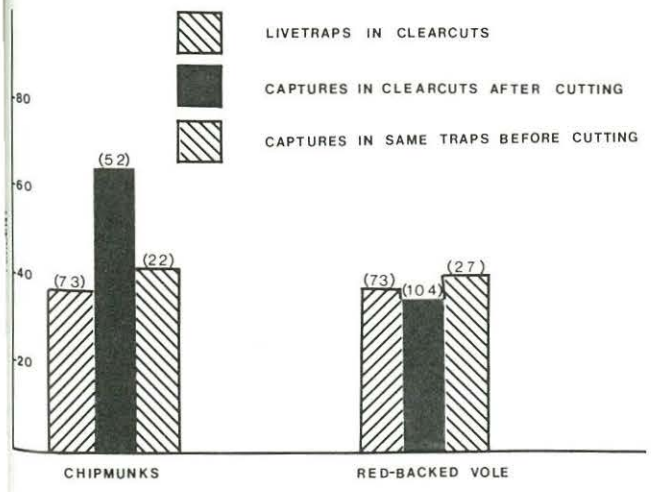

Fig. 2. Percents of red-backed voles and chipmunks caught in clearcuts compared with the same trap locations before cutting. Numbers of captures and traps are shown in parentheses.

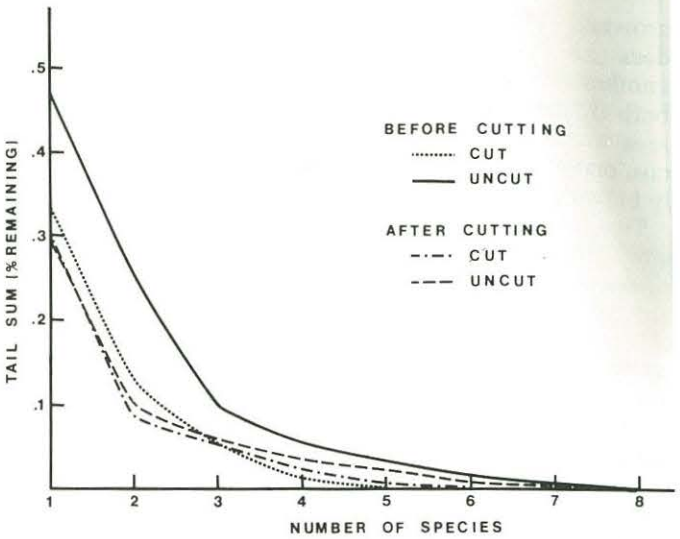

Fig. 3. Species diversity profiles of mammal community on Deadhorse Watershed, Colorado. Trapping results of 2 years pretreatment and 2 years posttreatment are included (Patil and Taillie 1979).

Discussion

After treatment, the number of small mammal captures was 33% higher on the treated drainage compared with the untreated; however, the increase was not significant. Chipmunks favored the clearcuts after harvest (fig. 2), but red-backed voles showed little preference for clearcuts or uncut areas. Gashwiler (1970) found red-backed voles in clearcuts when slash was still present, but they were not present during 9 years after the slash was burned. The results here are consistent with the data of V. H. Reid,[3] indicating an increased use of clearcuts by chipmunks and little change in red-backed voles when slash remains.

A bird and mammal species diversity profile was prepared following Patil and Taillie (1979). Lines in the profile that do not cross have a difference in diversity whereas those that cross are not different. Pretreatment mammal species diversity was greater than posttreatment on the uncut drainage and not different pre- and posttreatment on the cut drainage (fig. 3). Posttreatment species diversity was not different between the treated and the untreated drainage.

Bird numbers were very low on both drainages in spring 1977, following an extremely dry winter and spring when winter precipitation was 67% of normal.[5] Population density estimates in the drainage with clearcuts declined by 11% when compared with the 2 years before treatment, whereas estimated numbers increased by 8% on the uncut drainage. Ruby-crowned kinglets and mountain chickadees accounted for much of the decline. Both are foliage feeding birds. Ruby-

[5] *Data on file at the Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.*

crowned kinglets nest in foliage, and mountain chickadees are cavity nesters. Yellow-rumped warblers, another foliage feeding and nesting bird, increased on both drainages but the increase on the timber harvest area was less than on the uncut area. Gray-headed juncos, one of the few ground nesting species, had a slightly higher population density after timber harvest.

Two new species were found on the treated drainage after treatment—Lincoln's and song sparrows. Both prefer dense shrubs for singing and usually nest on the ground in dense shrub areas. Small groups of alder (*Alnus tenuifolia*) were present on the moist sites in the treated drainage. When the overstory of conifers was removed, habitat was improved for these two bird species. The olive-sided flycatcher utilized the tops of snags in the clearcuts for feeding and singing and increased in numbers after logging.

Bird species diversity profiles were similar for both drainages before cutting and for the uncut drainage in the posttreatment period (fig. 4). The diversity profile indicated a higher species diversity on the cut drainage after logging.

Hagar (1960) found a temporary decline in bird numbers in clearcut Douglas-fir in California. After clearcutting, species composition of birds changed, but the total number was about the same within 1 year after timber harvest. In the subalpine zone, invasion of grasses, forbs, and shrubs is much slower than in the Douglas-fir forests of California, and recovery in number of birds would be expected to be slower.

In this study, fewer birds were counted on the treated drainage after the small blocks were clearcut, but there was a small increase in numbers of species occurring in the drainage. This water yield improvement practice provided an added dimension of habitat to the forest environment, because the cuttings accommodate bird species requiring habitats in early successional stages. Wildlife species requiring old-growth habitat may not have been adversely affected by the small patch-cutting on a relatively small scale. Considerations for these species should be included in long range cutting plans if additional patch clearcutting is anticipated.

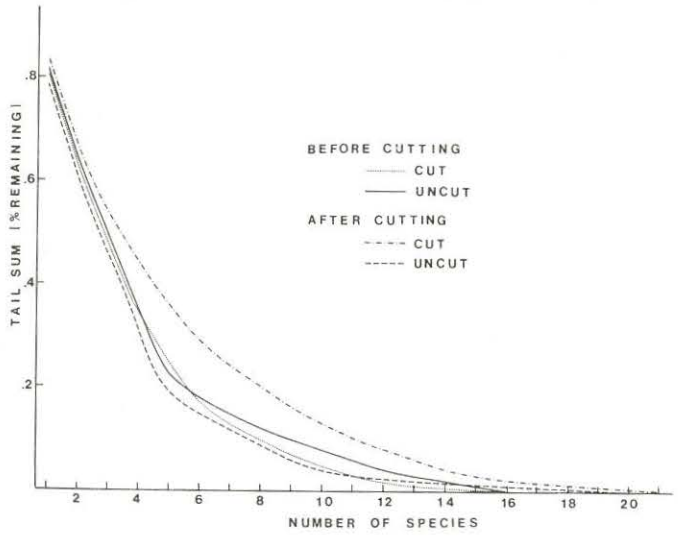

Fig. 4. Species diversity profile of bird community on Deadhorse Watershed, Colorado. Bird survey results of 2 years pretreatment and 2 years posttreatment are included (Patil and Taillie 1979).

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Appendix I

Common and Scientific Names of Animals Found on the Study Area

Birds

Sharp-shinned hawk	*Accipiter striatus*
Blue grouse	*Dendragapus obscurus*
Common nighthawk	*Chordeiles minor*
Broad-tailed hummingbird	*Selasphorus platycercus*
Williamson's sapsucker	*Sphyrapicus thyroideus*
Hairy woodpecker	*Picoides villosus*
Three-toed woodpecker	*P. tridactylus*
Northern flicker	*Colaptes auratus*
Olive-sided flycatcher	*Contopus borealis*
Western wood pewee	*C. sordidulus*
Western flycatcher	*Emipidonax difficilis*
Gray jay	*Perisoreus canadensis*
Common raven	*Corvus corax*
Black-capped chickadee	*Parus atricapillus*
Mountain chickadee	*P. gambeli*
Red-breasted nuthatch	*Sitta canadensis*
White-breasted nuthatch	*S. carolinensis*
Brown creeper	*Certhia americana*
Golden-crowned kinglet	*Regulus satrapa*
Ruby-crowned kinglet	*R. calendula*
Townsend's solitaire	*Myadestes townsendi*
Hermit thrush	*Catharus guttatus*
American robin	*Turdus migratorius*
Yellow-rumped warbler	*Dendroica coronata*
Song sparrow	*Melospiza melodia*
Lincoln's sparrow	*M. lincolnii*
Dark-eyed junco	*Junco hyemalis*
Pine grosbeak	*Pinicola enucleator*
Red crossbill	*Loxia curvirostra*
Pine siskin	*Carduelis pinus*

Mammals

Masked shrew	*Sorex cinereus*
Dusky shrew	*S. monticolus*
Least chipmunk	*Eutamias minimus*
Golden-mantled ground squirrel	*Spermophilus lateralis*
Red squirrel	*Tamiasiurus hudsonicus*
Deer mouse	*Peromyscus maniculatus*
Bushy-tailed woodrat	*Neotoma cinerea*
Red-backed vole	*Clethrionomys gapperi*
Heather vole	*Phenacomys intermedius*
Vole	*Microtus* sp.
Western jumping mouse	*Zapus princeps*
Ermine (short-tailed weasel)	*Mustela erminea*